kept together for sending to great exhibitions in order to testify to the mineral resources of the country; specimens are added from time to time to replace breakages and to represent newly opened mines. The small specimens are arranged in flat table-cases; of the large specimens, the more valuable are placed in large upright cases, and the remainder are piled near by in the open court. Information as to the nature of the ore, and in some instances the minerals present and the locality, is given on the labels accompanying the specimens. We may pass over the gold specimens from British Columbia and the Yukon district, and direct attention to the extensive series of silver associated with smaltite, niccolite, erythrite, &c., from the rich mines of Temiskaming, Ontario, first discovered five years ago. Some large crystals of phlogopite and apatite, and a small polished piece of beautiful blue sodalite, may be noticed.

In the Australia Hall the several component States have worked in their own courts independently, and not always on similar lines. In the Western Australia court the organisation and arrangement of the minerals have been managed entirely by the Government, and the result, as regards both the type of show-case and the selection and labelling of the specimens, is admirable. The gold industry naturally takes a prominent position. Some rich specimens of tellurides are shown, but they reveal no signs of crystal form. At the somewhat analogous district of Cripple Creek the telluride of gold, calaverite, occurs in many-faced crystals, the symmetry of which has been such a baffling problem. The tantalite from Greenbushes is interesting as the source of the filament of the new electric lamp; generally it is found in curiously marked massive pieces, but one or two specimens show unmistakable indications of crystal form. A huge lump, said to be only a portion of the original mass, testifies to the size attainable by tin-stone. At the principal entrance to the Queensland court are placed cases containing both rough and cut examples of the gem-stones found in the southern and central districts, viz. opal, colourless topaz, green and yellow sapphire, pink and green tourmaline, and pale green beryl. Conspicuous among them is the novel "black opal," which is of various shades to the deepest blue, and flames with vivid opalescence. Among the ore specimens at the further end of the court may be noted a bright wolframite and a fine bismuth. The gem-stones occurring in New South Wales are very similar to those just mentioned; perhaps the best black opal, of which some exceptional specimens are exhibited, comes from Lightning Ridge. Few good specimens from the famous Broken Hill mines are to be seen, and the arranging and labelling in at least two of the show-cases leave much to be desired.

Time, unfortunately, has not permitted of the organising of a collection of typical minerals in the India Hall. The Ruby Mines, Ltd., however, exhibit a magnificent series of rough and cut rubies and sapphires from Burma; no attempt is made to distinguish between the species corundum and spinel. Those interested in minerals will find much to attract them in the finely-crystallised specimens from the new lead and zinc mines at Broken Hill, North-Western Rhodesia, exhibited by Mr. Percy C. Tarbutt in the British Science Hall. They will see the zinc phosphates, hopeite, previously to the discovery of these mines known only by a few rare crystals, and tarbuttite, a new species, which was named after the exhibitor by Mr. L. J. Spencer, who recently described this remarkable mineral occurrence. In the same case Mr. Arthur Russell shows some minerals from the British Isles, mostly from abandoned mines or unrecorded localities, and Mr. F. N. A. Fleischmann exhibits a series of zeolites from the basaltic lava near Belfast.

Probably never before has such a superb collection of fashioned gem-stones been brought together for public view as are exhibited in the French and British Applied Art Halls. Space, however, permits us to direct attention only to the remarkable series of coloured diamonds exhibited by M. Eknayan in the former hall.

G. F. H. S.

PROTECTIVE DEVICES FOR HIGH-TENSION TRANSMISSION CIRCUITS.

IN the Journal of the Institution of Electrical Engineers issued in June (vol. xl., No. 189), Mr. J. S. Peck describes some methods in use for protecting high-tension transmission circuits from lightning and other high-voltage discharges. The development of apparatus for this purpose has received little attention in Great Britain owing to the fact that there are comparatively few overhead systems working at pressures greater than 11,000 volts, and severe thunderstorms are of very rare occurrence. On the Continent and in America, however, where very high voltages are used in overhead systems, and where thunderstorms are more frequent and severe, it has been essential for the success of transmission to develop considerably such protective devices.

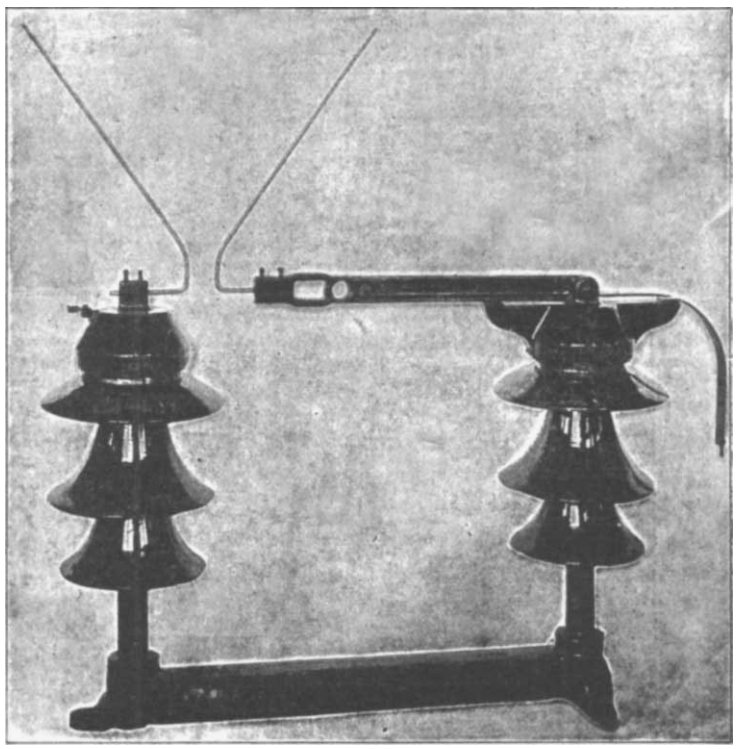

FIG. 1.—Horn-type gap.

Generally speaking, the effect of a lightning discharge on the circuit will be to cause a large increase of potential at certain points. Should the line insulation be insufficient, the charge may jump to earth, shattering poles, but probably protecting the apparatus at the end of the line from damage. If there is no escape in this direction, then there is the possibility of the insulation of the end apparatus breaking down, which is very serious.

Similar dangers may arise from sudden shorts in the system itself, and in dry climates the wind blowing over the transmission wires has been found to build up a high static potential. It is essential, then, to devise apparatus (1) to prevent concentration of potential at the end wind-

ings, and consequent shorts between adjacent turns; (2) to prevent excessive voltage between the wires and ground, causing breakdown to ground over insulators. To avoid (1), recourse may be had to high insulation, but this is not always practicable, and generally well-insulated choking coils are placed between the line and the terminal apparatus. If these break down they may be easily taken out and repaired. For (2), "lightning arresters" must be used. The essentials of such an arrester are that it must form an easier path to earth than the insulation resistance of the transmission line or other parts of the apparatus, and yet it must hold back the line voltage. There must, in addition, be some device for suppressing the arc which accompanies the discharge.

One of the earliest forms of arrester was the horn type (Fig. 1). This consists of two wires, one connected to line and the other to earth. Each is bent at an acute angle, so that they diverge from one another vertically upwards. Their distance apart at the lowest point must be adjusted so that no arc will occur for small increments of normal line voltage, but if the potential of the line connected wire rises considerably, an arc is formed. This arc rises, increasing in length, and is finally ruptured.

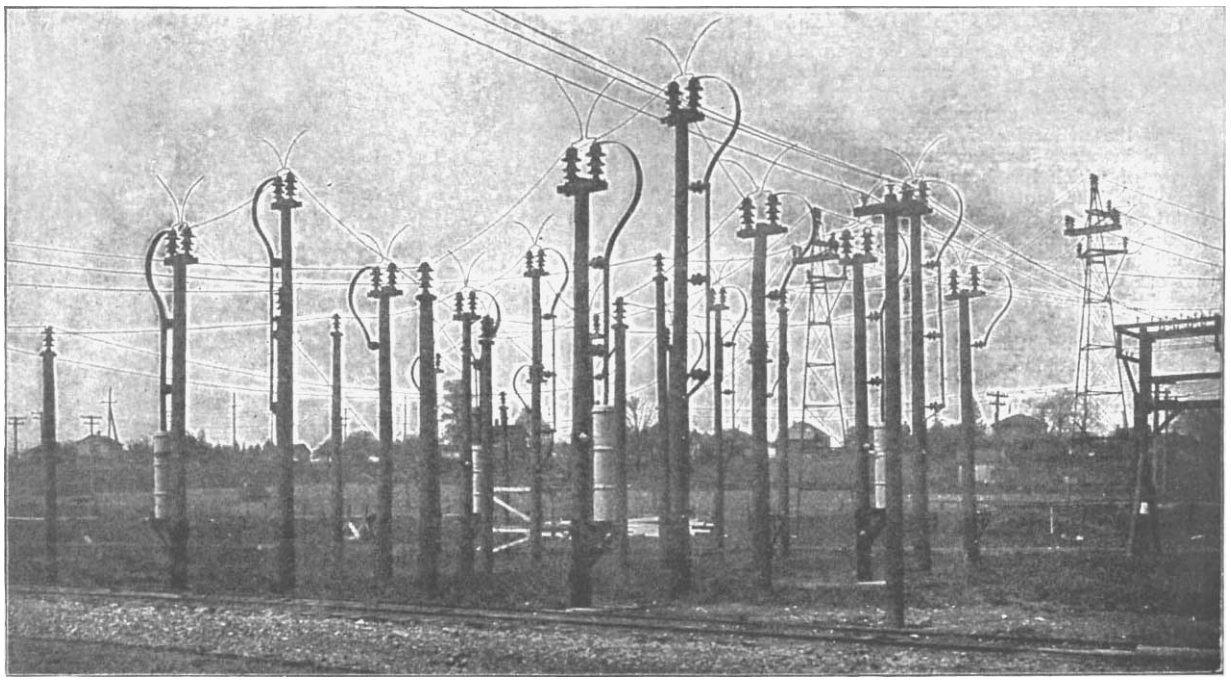

FIG. 2.—General view, 60,000-volt lightning arresters.

An objection to this form of arrester is the length of time elapsing between formation of arc and its rupture, for during this time the system is earthed. It is usual to place a high resistance in series with this arrester so that the current to earth from the line is diminished, but this will retard the static discharge. Owing to fusion of the metal at the lowest point where arcing occurs, it needs constant re-adjustment. An improved form is in use with an auxiliary gap and adjustable platinum point.

The "non-arcing multi-gap arrester" depends on the power certain metals have of suppressing an alternating arc. A number of cylinders of suitable metal are placed between line and earth. The cylinders are separated by gaps of 1/32-inch. They allow escape of the static charge, but no arcing occurs. These have proved most successful on low-voltage systems (2000 volts).

On the Continent, an arrester consisting of jets of water playing upon the line has been used. The chief objection to this is that it allows leakage of current from line to earth. The latest type of protecting device is the "electrolytic arrester." If aluminium electrodes are placed in certain electrolytes a non-conducting film is formed on the surface of the metal. This film can withstand a pressure of about 400 volts. At higher potentials it is punctured with a series of small holes, and the cell becomes conducting. When the excess voltage is removed the non-conducting film re-forms. By building up a number of such cells in series they may be made to withstand any desired voltage. Such a series is contained in a cylindrical earthenware vessel, the number depending on the normal line voltage, and is connected between line and earth (Fig. 2). It is usual to have a gap between line and electrolytic unit. For voltages not exceeding 13,500 volts, a non-arcing metal-cylinder gap may be used; for larger voltages one of the horn type is usual. Such arresters have been adapted successfully to lines with voltages varying from 4000 to 60,000 volts.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

THE annual congress of the Royal Institute of Public Health was held at Buxton from July 18–24. Among the many and varied subjects which were discussed, the following papers aroused considerable interest and discussion:—

Sir James Crichton-Browne took for his presidential address to the preventive medicine section "Parsimony in Nutrition." He did not concern himself with any particular dietetic system, but considered the general dietetic tendency towards abstemiousness which exists at the present day. Detailed reference was made to the dietary standards of Profs. Voit, of Munich, and Atwater, of the United States. These standards have been since found to be too high. An American, Mr. Horace Fletcher, showed that by careful and thorough mastication and insalivation the bodily needs are not only satisfied by a smaller amount of food, but the tone of the body is improved. Prof. Chittenden's careful researches on the subject led him to conclude that half the amount of proteids formerly considered necessary are quite sufficient. It was pointed out that before our dietetic system was revised on any such lines, it was essential to consider other facts. Concomitant with the proteid-consuming habits of the western races there had been a development of increased precision in